



Analysis of transport system in a semi-urban village: A case study of Jagatpur Village, Delhi, India

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ABSTRACT

“Jagatpur” is a resettled semi-urban village adjoining “Jharoda” village near Burari by-pass in Delhi, India. The village has many problems that need attention. The village is isolated from other important places due to lack of any systematic transport means. Earlier it had a proper public transport system but due to encroachment of the area near the chowk from where the DTC buses take a turn and lack of proper planning, the transport has become a very big problem in this village.

The aim of this study is to find a solution to the problem and come up with a proposal for an efficient public transport system in the village which is eco-friendly, economical and convenient to the villagers. Some important roads and vacant space inside and outside of the village were analyzed and measured, so that possible routes that could connect the village to the main roads and the nearest Metro Station could be suggested. In this study, the authors also propose a sustained route plan of DTC bus (with timings) and Gramin sewa for the most preferred route by villagers that was obtained by survey.

Keywords: *chowk, gali, semi-urban village, steering angle, transport, turning radius*

INTRODUCTION

Jagatpur is a semi-urban village with a population of thousands. Before 1952, Jagatpur village was situated at the Yamuna bank and it got submerged due to flood. At that time, the representative of the executive council established a multipurpose cooperative society that resettled the village to the current place. At the time of resettlement, a well-organized plan/map was laid out for the village. The village is mapped in such a way that, it has 9 lanes that are connected to a *chowk*² in the village. In this plan the area surrounding near the chowk (16 plots) was divided into 4 equal parts in which, place for girls school and 2 seed stores were allocated. The yellow

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² *Chowk*: A small intersection of roads

shaded parts are the major 9 lanes of the village and the red shaded parts are the 4 equal plots (Figure I).



Figure I: Layout of newly resettled Jagatpur Village in 1950's

This *chowk* was earlier connected to the main road through the DTC bus service, which had a bus stop at this *chowk*. 6-7 years back, 2 buses connected Jagatpur village to nearby places.

- Route No. 271 – Jagatpur to Central Secretariat
- Route No. 266 – Jagatpur to Shivaji stadium

However, within a year or two the buses stopped running due to less profits and lack of enough space due to encroachment. Presently, only bus no. 271 comes once at 8:20 am in the morning and then changes its route from ISBT to Kapasheda Border.

In the beginning of 2012, 27 Gramin sewa were sanctioned on the route of Jagatpur. But all the drivers have refused to do the turns in Jagatpur as they do not get any profit and encounter other problems with the villagers. Villagers are finding it very difficult to commute to others places. Rich people of the village have their own vehicle and those who don't have any, sometimes travel with those who have; otherwise they have to walk all the way to Gandhi Vihar or Wazirabad stop.

There is one main *gali*³ from which the buses used to enter, turn at *chowk* and return back. Earlier this chowk was the designated place for the DTC buses, when there were no houses and shops at the corners of the chowk. But now the area surrounding the chowk is encroached that creates problem for the buses to turn. After the encroachment, the chowk has become so narrow so there is no space left for the turning of the buses as shown in figure II.

Earlier the redshaded region was free space for the buses to take turn that has now been encroached. The Govt. girl's school (shaded in orange) is the only allocated region according to the plan.

³*Gali*: Small lanes in a village

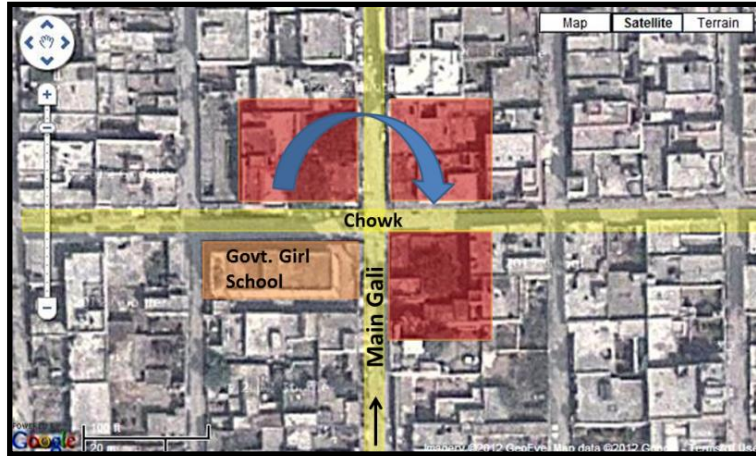


Figure II: Jagatpur Village Chowk View

METHODOLOGY

A proper road analysis of the roads in the village was done which included

- The measurement of the roads
- Drawing a proper map of all the main roads and gali of the village (Figure III)
- Analyzing the empty space nearby the chowk (Figure IV)

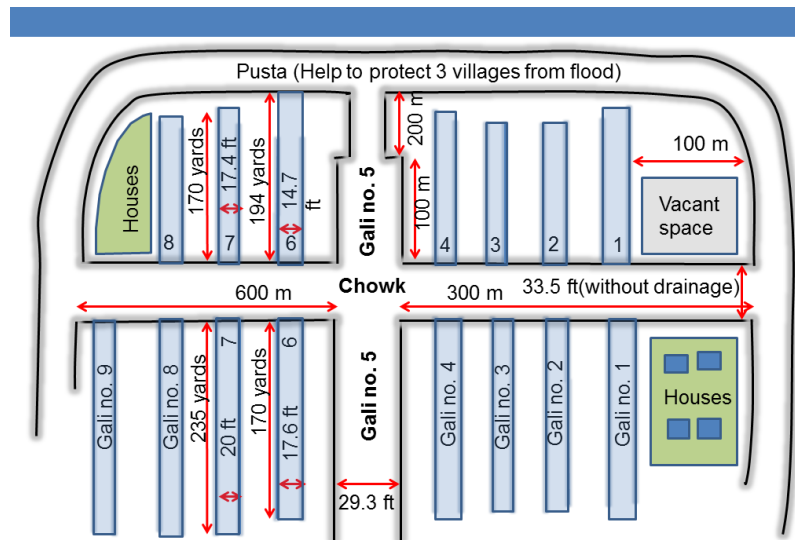


Figure III: Pictorial representation of Jagatpur village map

At the time of resettlement the layout of the village was same but there was no mention of the *gali* numbers and house numbers. When the RWA of the village was formed in 2005, they put up sign boards indicating the house and the gali numbers. The village is mainly divided into nine lanes that are parallel to each other. Gali number 5 is the main gali of the village with a width of 29.3 ft. About 300 m away to the right of the chowk is a huge disputed vacant land. This land belongs to a family of Jagatpur village.

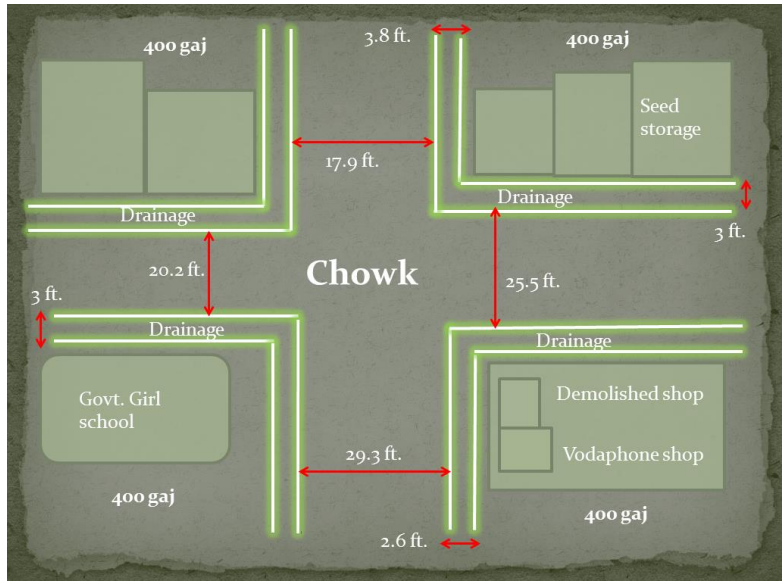


Figure IV: Pictorial representation of Jagatpur village chowk

The four corner of the *chowk* have equal space of about 400 *gaj*. Earlier, except for Govt. girl school, the other three sides were vacant. But now these three sides have been encroached. One of the corner had two shops (out of which, one is demolished and other has got the notice to demolish) (Figure IV). Earlier, when the three corners were vacant, buses would come to the chowk, take a U - turn and go back through the same route. But now due to lack of space for turning the buses have stopped entering the village.

A survey was also carried out to identify peak hours, route preferred by the villagers, average fuel consumption over a month, vehicle number in a family etc. On the basis of stratified random sampling fifty four houses, eachhaving an average of six members per house was surveyed to get the details. More than three hundred villagers were interviewed randomly to get the primary data during the survey. The outcomes of the survey are plotted in Figures V – VII. From the survey, we could conclude that most of the villagers (33%) preferred the route to Gandhi Vihar (Figure V)

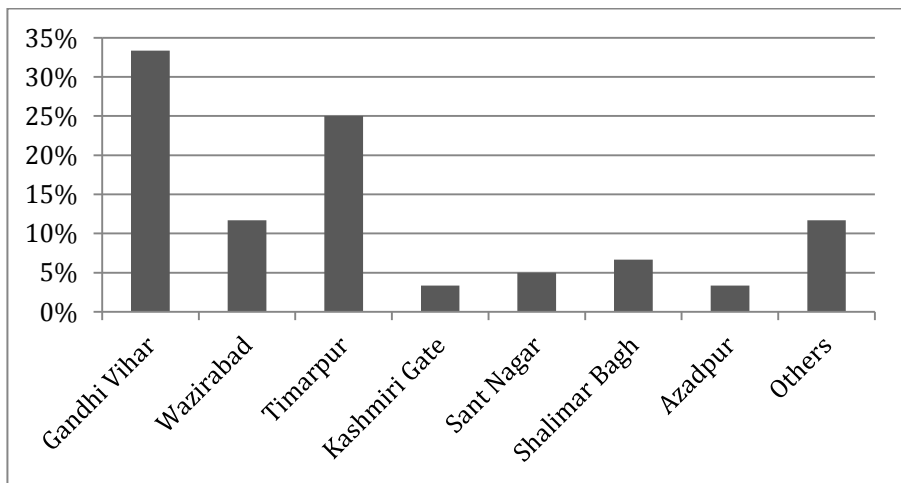


Figure V: Percentage of people of Jagatpur with preferred route

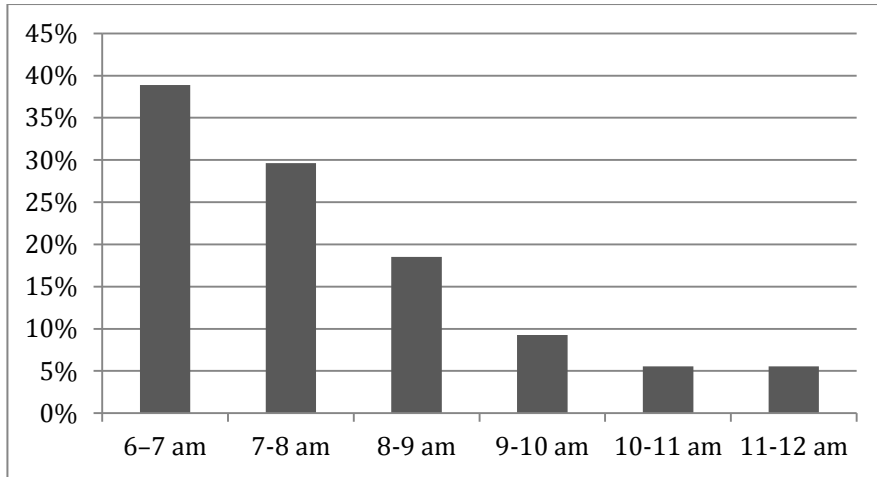


Figure VI: Percentage of people of Jagatpur for morning hour's frequency

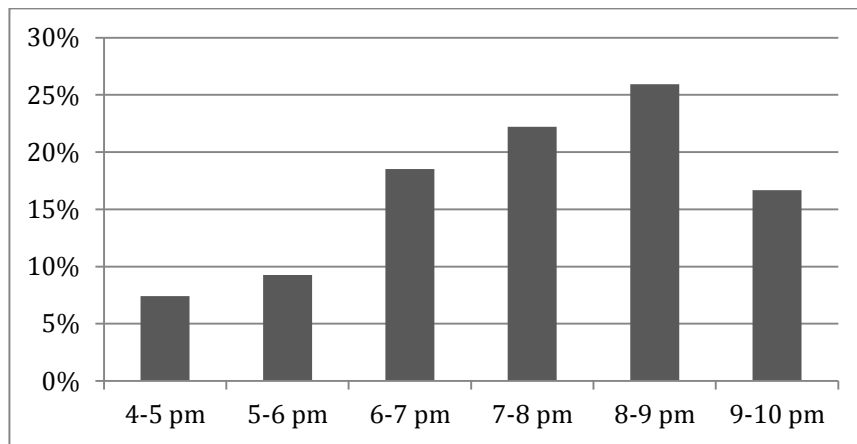


Figure VII: Percentage of people of Jagatpur for evening hour's frequency

The conclusions from the survey are tabulated in Table I

Table I: Results of survey

1.	Most preferred routes by villagers	Gandhi Vihar (20), Timarpur (15) and Wazirabad (7)
3.	Average no. of villagers going out of village (working, college, school)	3.02 per household
4.	Fuel expenditure of a house for a month	Rs-1,852 per month
5.	Morning peak hour	6:00 am to 9:30 am
6.	Evening peak hour	6:00 pm to 9:30 pm

From the survey it was felt that there is a need to provide a better public transport in the village because it would not only help the villagers but also save - fuel (which will be eco-friendly), money (as public transport is cheaper), time of the villagers (as some have to walk or wait for others to take lift).

RESULTS

A. Analysis of the available transports

Delhi Transport Corporation (DTC) Buses:

Ministry of Transport took over the local bus service of Delhi in 1948. It was initially named "Delhi Transport Service" and later was constituted as "Delhi Road Transport Authority". The present day Delhi Transport Corporation which was under administrative control of the Indian government has now been transferred to the Government of National Capital Territory, Delhi. A survey at the bus terminal of Mukherjee Nagar regarding the maintenance cost of DTC buses over a period of one month was carried out. The observations have been tabulated in Table II.

Table II: Detail of a DTC bus

S.No	Observation about DTC bus		
1.	Length of the DTC bus	34.5 ft. (10.51 m)	
2.	Breath of the DTC bus	8.5 ft. (2.59 m)	
3.	Average/mileage of the bus	Old – 2.5 to 3 km/kg New – 3.5 to 4 km/kg	
4.	Money spend on a DTC bus in one day	Around 3,000/- Rs	
5.	Maximum people accommodate in a DTC bus in best case	Around 80 (50 seating + 30 standing)	
6.	Ordinary service fair (non-AC)	Kilometer	
		Fair	
		Upto 4 kms	Rs. 5/-
		4-10 kms	Rs. 10/-
		10 km onwards	Rs. 15/-
		[1]	
7.	Green card for a day	Rs. 40/- (non-AC) &Rs. 50/- (AC)	

Gramin Sewa

A new para-transit service called the “Gramin Sewa Scheme” have been initiated in Delhi wherein high capacity three-wheelers with seating capacity of six passengers excluding driver and/or one helper have been given permits to ply in rural areas as well as unauthorized, resettlement and JJ colonies. The service is required to provide sustainable, efficient, effective and environment friendly transit service that serves the needs of a locality by connecting local destinations and providing better access to popular destinations such as transport nodes, commercial center’s etc. At present, in most of the places of Delhi, Gramin sewa are “*Dhehadee*⁴” based, means the person who is driving have to pay a fixed amount to the owner of the vehicle on a daily basis. The observations about Gramin Sewa are listed in Table III.

⁴*Dhehadee*: Giving rent to the owner for borrowing their things

Table III: Detail of a Gramin Sewa

S.No	Observations about Gramin Sewa		
1.	Cost of one Gramin Sewa	Around 6 lakh	
2.	No. of people accommodate at one time	9-10	
3.	Average/mileage	14-16 km/kg of CNG	
4.	Other maintenance cost over a month	Rs. 3-5 thousand	
5.	Capacity of fuel	Maximum: 8 kg, Store: 7 kg	
6.	Ordinary service fair	Kilometer	
		Fair	
		Upto 3 km	Rs. 5/-
		Upto 7 km	Rs. 10/-
		7 km onwards	Rs. 15/-
[3]			

B. Mathematical Analysis

Minimum turning path for DTC bus

To calculate the minimum turning path for DTC bus we assume the following (figure VIII)

- The effects, such as, speed at which the driver makes a turn and slip angles of wheels are minimized by assuming that the speed of the bus for the minimum turning radius is less than 16 km/h.
- The boundaries traced by the turning paths of DTC bus for its sharpest turns are established by the outer trace of the front overhang and the path of the inner rear wheel. This turn assumes that the outer front wheel follows the circular arc defining the minimum centerline turning radius as determined by the vehicle steering mechanism.

In figure VIII, minimum turning path of a DTC bus is traced by using its minimum turning radius. When the bus is taking a turn, four radial paths are traced from different position of the bus:

- Radius, from inner side of the bus which is minimum (i.e. 7.25 m [23.8 ft])
- Radius, from outer side of the bus which is 11.86 m [38.9 ft]. This is the minimum turning radius for the bus.
- Radius, from the center of the front axle which is 10.64 m [34.9 ft]. This is called centerline turning radius (CTR).
- Radius, from the front overhang of the bus which is maximum (i.e. 12.04 m [39.5 ft]).

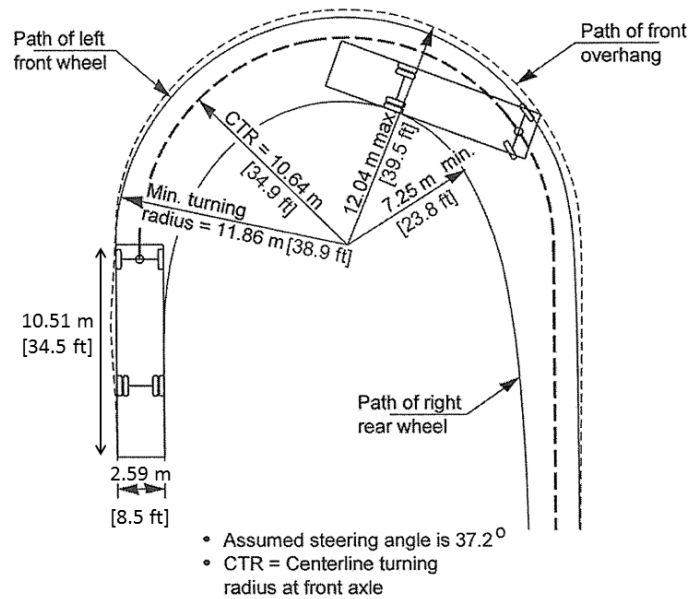


Figure V: Minimum turning path for DTC bus

Image source: [2]

The steering angle of the DTC bus is around 37.2 degree. The steering angle of the DTC bus is calculated using the formula [2]:

$$\text{Turning circle} = \frac{\text{Track}}{2} + \frac{\text{Wheel Base}}{\sin(\text{average steer angle})}$$

where,

Track is the length of axle,

Wheel base is the length from the center of the front wheel track to the center of the rear wheel track

and

$$\sin(\text{average steer angle}) = \frac{\text{Wheel Base}}{\text{Turning Circle} - 0.5 * \text{Track}}$$

Using the dimensions of the DTC bus the approximate value of the steering angle is $36.16^\circ \approx 37.2^\circ$.

Motion of the DTC bus near Chowk

The motion of the DTC bus near the chowk can be divided into following parts

- (i) Straight motion through *Gali* No. 5
- (ii) Turning of the bus
 - a. 90° turn using a by-lane
 - b. 180° turn near the *chowk*

Straight motion

Suppose a DTC bus is going straight through the *Gali* no. 5, then the width of the road must be greater than the width of the bus. That is, the width of the road must be

greater than 2.59 metres and some space between boundary and bus, on both the sides of bus (figure IX)

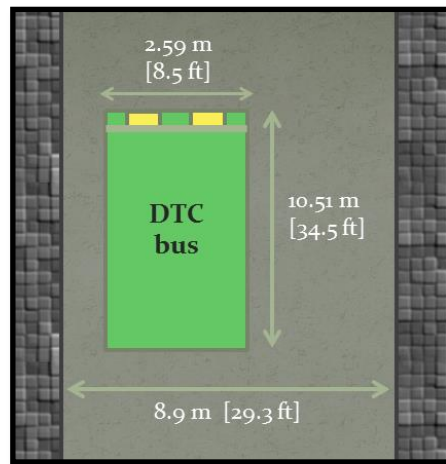


Figure VI: Straight motion of bus

DTC bus can easily move in a straight line in Jagatpur village through Gali no: 5, because width of the gali no: 5 is 8.9 metres i. e. 29.3 feet.

Turning of the bus

a. 90° turn using a by-lane

If bus has to take 90° sharp turn then the steering angle must be maximum. At maximum steering angle 37.2° , the turning radius is 11.86 m. Total space required by DTC bus for turning 90° = turning radius + width of the bus + some space between bus and boundary = 16 m

So, to take 90° turn to right side of chowk bus has to use this right lane also. The width of this right lane and gali no: 5 connecting the chowk must be equal to or greater than 16 m i.e. width of the right lane is 7.8 m [25.5 ft] and width of the gali no: 5 is 8.9 m [29.3].

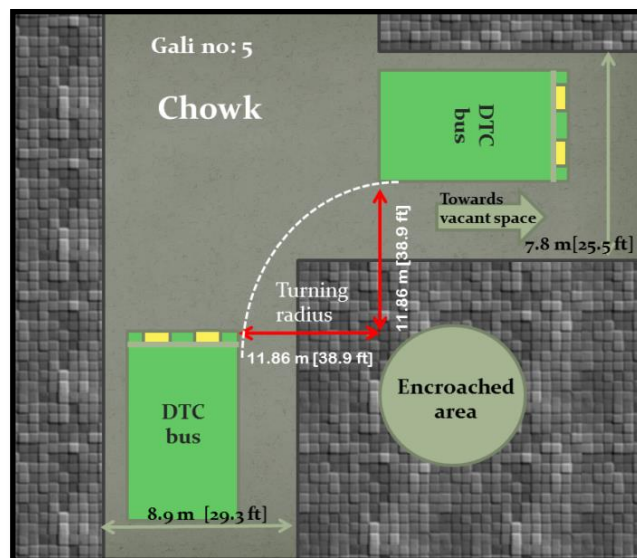


Figure VII: Motion of 90 degree turn using by-lane

It is assumed that center of the turning radial circle is taken on the encroached part because it's just an imaginary point consider in mind to take turn. For turning, the main focus of our mind is on quarter-semi curved. So considering the right lane with assuming the central radial point is on the encroached area buses can easily take turn.

Hence DTC bus can easily take turn to right if the vacant space is utilized for the stop purpose. Similarly many school buses of same size as DTC bus follow this route.

In reality at sharp cuts, when space is very less for turn, generally a vehicle little moves forward then backward, again little forward and backward and in this way, vehicle completes his turn. But at that time the traffic near to that lane has to stop for some time till the vehicle do not take complete turn.

b. 180° turn near the chowk

Earlier when these encroached parts are vacant, buses usually come near the chowk, take 180 degree turn and moves back, but now it is very difficult. If buses have to follow the same earlier pattern of 180 degree than some part has to be demolished so that it is easier for the bus driver to take 180 degree turn (figure XI)

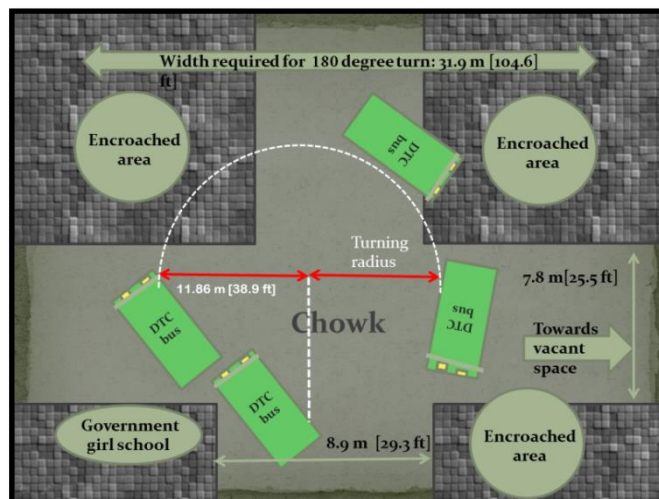


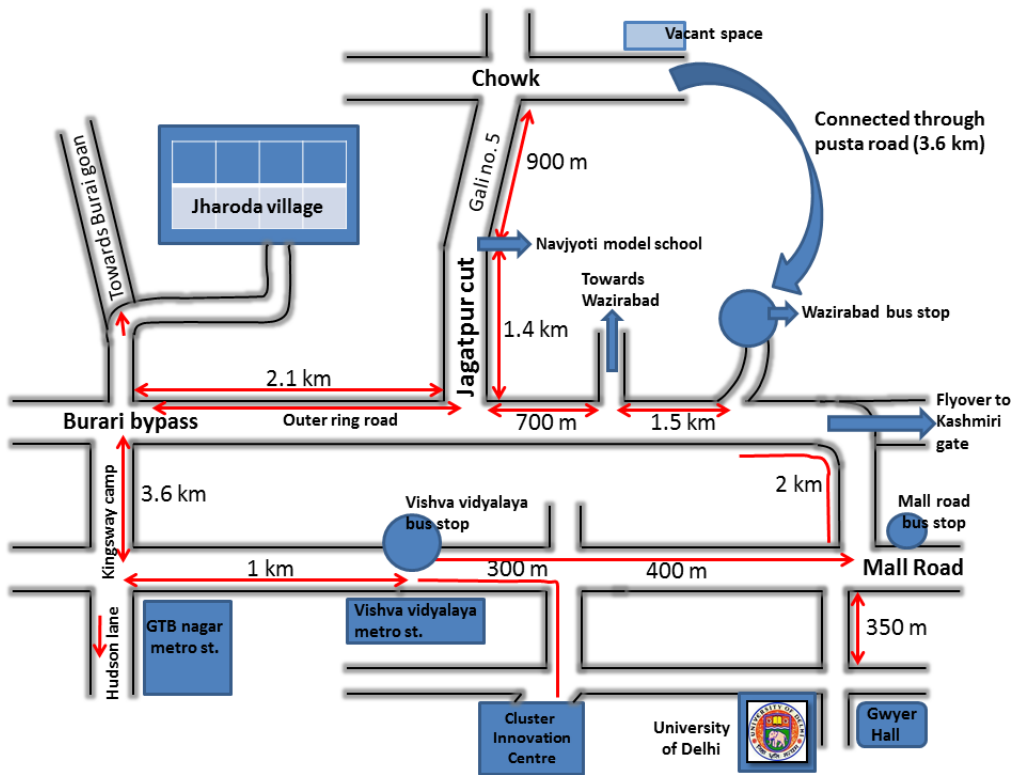
Figure VIII: Motion of 180 degree turn near the chowk

$$\begin{aligned}
 &\text{The width required to turn bus by } 180^\circ \\
 &= 2 \times \text{turning radius of bus} + 2 \times \text{width of the bus} + \\
 &\quad 2 \times \text{some space between bus and boundary} \\
 &= 11.86 \times 2 + 2.59 \times 2 + 2 \times 1.5 \text{ (assume)} \\
 &= 31.9 \text{ meters}
 \end{aligned}$$

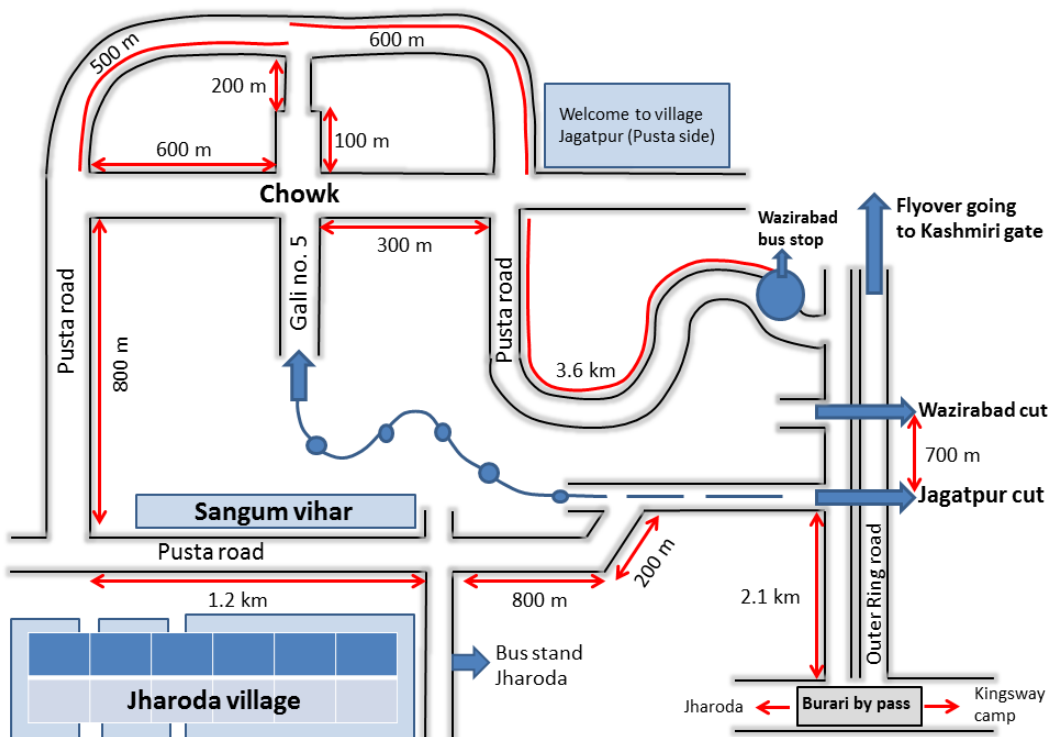
Hence if by demolition around 32 meters wide space is created, then this 180 degree turn will again be possible.

Available option for routes

In order to find out the possible optimum route, maps of the road, and routes of the necessary places that connect the village Jagatpur along with their distances are drawn. The maps can be easily used to calculate the distance required to be travelled by a DTC bus and Gramin sewa. Some of the feasible options available to connect with nearest transport nodes from Jagatpur village are tabulated in Table IV.



(a)



(b)

Figure IX: Nearest transport nodes to Jagatpur village

Table IV: Option for feasible Routes

Options	Route	Total kilometers
Option 1	GTB nagar, Kingsway camp, Burari bypass, Jagatpur cut, gali no. 5, chowk, vacant space (turn from here and return back through same route) [fig 12(a)]	GTB nagar to vacant space = 8.3 km 2x700 m=1.4 km (extra for U-turn on outer ring road) Total = 8.3 +8.3+1.4= 18 km
Option 2	GTB nagar, Kingsway camp, Burari bypass, Jagatpur cut, gali no. 5, chowk, vacant space (turn from here), chowk, Jagatpur cut, Wazirabad cut, Kashmiri gate flyover, mall road, Vishwa vidhayala, GTB nagar. [fig 12(a)]	GTB nagar to vacant space = 8.3 km Vacant space to mall road= 6.8 km Mall road to GTB nagar=1.4 km Total =8.3+6.8+1.4=16.5 km
Option 3	GTB nagar, Kingsway camp, Burari bypass, Jagatpur cut, gali no. 5, chowk, vacant space, pusta road , Wazirabad stop, Kashmiri gate flyover, mall road, Vishwa vidhayala, GTB nagar. [fig 12(a)]	GTB nagar to vacant space = 8.3 km Vacant space to Wazirabad stop=3.6 km Wazirabad stop to GTB nagar=3.5 km Total =8.3+3.6+3.5=15.4 km
Option 4	GTB nagar, Kingsway camp, Burari bypass, Jharoda village stop, pusta road, side of chowk, vacant space, pusta road , Wazirabad stop, Kashmiri gate flyover, mall road, Vishwa vidhayala, GTB nagar. [fig 12(a) & 12(b)]	GTB nagar to Jharoda = 4 km Jharoda pusta to vacant space=3 km Vacant space to Wazirabad stop=3.6 km Wazirabad stop to GTB nagar=3.5 km Total=4+3+3.6+3.5=14.1 km

From the options available in Table IV, we can conclude that

For DTC buses:

- **Option 1** is valid as on the outer ring road there is cut available between two roads for making U-turn near the Wazirabad cut. This option is not best as per the requirement of the villagers because it can't connect bus through Timarpur and mall road side. Also, if any villagers have to go to this route they can easily de-board the bus near Wazirabad and take another bus following the same route.
- **Option 2** is best route for the bus because this is only option in which bus can move easily and also, the most preferred places by villagers were covered.
- **Option 3** will not work for buses because as moving toward Wazirabad side through pusta road from back of the chowk, road becomes narrow.

- **Option 4** will also, not work for buses because, again in this, pusta road of Jharoda village and pusta road toward Wazirabad both involves whose road are narrow for DTC buses.

For Gramin sewa


All options are valid for Gramin sewa due to its small size so it can run on all options but the option 1 and option 2 is most preferred and suitable route which cover all the necessary places according to the survey done with the villagers.


Option 3 and option 4 is not effective route because of the pusta roads, as less number of the passenger will be present on these roads due to its narrowness. Also if Gramin sewa encounter any break down problem, like puncture, fail to start, low fuel there would be no prompt aid available.

DISCUSSION

A. Sustained route plan

According to our survey done in the village we had found that most of the people are going towards Gandhi vihar, Wazirabad and Timarpur area. So the focus must be more on a route which will cover these places. We have also seen that frequency of people going out of the village is more between 6:00 am to 9:30 am (figure VI) and returning back to village is also in between 6:00 to 9:30 pm (figure VII). By considering all above constraints in our mind the proposed route plans for Jagatpur village for option no.2 are shown in Table 5 (timings for bus in morning frequency hours when buses go from Jagatpur village to GTB Nagar) and Table 6 (timings for bus in evening frequency hours when buses come to Jagatpur village from GTB Nagar). Before seeing the tables, meanings of the different colors used in the table:

 This Green color is availability of bus according to peak hours, means in the morning time villagers need buses from Jagatpur village to go out, while in the evening time villager need buses from the GTB nagar to come back. So each Green box in both tables represents availability of buses at different timing in the peak hours at the starting stop.

 This Red color is ending stop (last stop) in the route, means buses while completing its route have finally come to its last stop. So the timings written in red box means at this time bus reached to its last stop. So each Red box in both tables represents last stop of buses reaching at different timing in the peak hours from starting stop.

Apart from RED and GREEN colors used in the Table V and Table VI, there are two shades of GRAY colors also used in column of Bus 1, Bus 2 and Bus 3. These two different light and dark shades of GRAY colors in the column shows a complete cycle of bus from chowk to chowk in Table V and from GTB nagar to GTB nagar in Table VI. Means the bus completes one cycle when it reaches the same place from where it starts.

Table V: Timing of the buses (Morning Hours Frequency)

Time (am)	Bus 1	Bus 2	Bus 3
6:00	Chowk		
6:15	Jagatpur cut		
6:30	mall road via timarpur	chowk	
6:40	GTB nagar, Kingsway camp		
6:45	Kingsway camp	Jagatpur cut	
7:00	Burari bypass		chowk
7:05	Jagatpur cut	Mall road via timarpur	
7:15		GTB nagar	Jagatpur cut
7:20	Chowk via gali no. 5	Kingsway camp	
7:35		Burari bypass	
7:30	Chowk		
7:45	Jagatpur cut	Jagatpur cut	Mall road via timarpur
8:00		Chowk via gali no.5	GTB nagar
8:10	Mall road via timarpur	Chowk	Kingsway camp
8:15			
8:20			
8:25	GTB nagar, Kingsway camp	Jagatpur cut	Burari bypass
8:30	Kingsway camp		Jagatpur cut
8:40			
8:45	Burari bypass		Chowk via gali no.5
8:55	Jagatpur cut	Mall road via timarpur	Chowk
9:00		GTB nagar	
9:10	Chowk via gali no.5	Kingsway camp	Jagatpur cut
9:20			
9:30	Chowk	Burari bypass	
9:35		Jagatpur cut	
9:40			Mall road via timarpur
9:45	Jagatpur cut		
9:50	Wazirabad cut	Chowk via gali no .5	GTB nagar
10:00			Kingsway camp
10:10			Kingsway camp
10:20	Mall road via Timarpur		
10:30	GTB nagar		Burari bypass
10:35	Kingsway camp (stop)		Jagatpur cut
10:50			chowk
11:00		Same route (chowk to GTB nagar)	
12:30			Same route (chowk to GTB nagar)

Table VI: Timing of the buses (Evening Hours Frequency)

Time (pm)	Bus 1	Bus 2	Bus 3
6:00	GTB nagar, Kingsway camp		
6:20	Burari bypass		
6:30	Jagatpur cut		
6:40		GTB nagar, Kingsway camp	
6:45	Chowk via gali no.5		
7:00	Chowk	Burari bypass	
7:10		Jagatpur cut	
7:15	Jagatpur cut		
7:20	Wazirabad cut		GTB nagar, Kingsway camp
7:25		Chowk via gali no.5	
7:30		chowk	
7:40	Mall road via timarpur		
7:45		Jagatpur cut	
7:50	GTB nagar	Wazirabad cut	Burari bypass
8:00	Kingsway camp		Jagatpur cut
8:10		Mall road via timarpur	
8:15			Chowk via gali no.5
8:20		GTB nagar	
8:25	Burari bypass		
8:30		Kingsway camp	Chowk
8:35	Jagatpur cut		
8:45			Jagatpur cut
8:50	Chowk via gali no.5	Burari bypass	Wazirabad cut
9:00	Chowk	Jagatpur cut	
9:15	Jagatpur cut	Chowk via gali no.5	
9:20	Wazirabad cut		Mall road via timarpur
9:30		Chowk to GTB nagar (stop)	GTB nagar (stop)
9:50	Mall road via timarpur		
10:00	GTB nagar (stop)		

In the morning peak hours 7 buses goes out of the village at timing 6:00, 6:30, 7:00, 7:30, 8:10, 8:55 and 9:30 am. Two buses are also available at time 11:00 am and 12:30 pm. In the evening peak hours 5 buses come in the Jagatpur village, means 5 buses are available at GTB nagar in evening for Jagatpur village at timings 6:00, 6:40, 7:20, 8:00 and 8:30 pm.

Also, according to light and dark shade of Gray color column boxes:

- In morning, Bus 1, Bus 2 and Bus 3 all complete 3 cycles.
- In evening, Bus 1 and Bus 2 complete 2 cycles while Bus 3 complete 1 cycle.

Apart from buses, Gramin sewa can also run in the Jagatpur village. In peak hours buses will run according to the route of option no.2 and follow the time table

according to the above two tables. Side by side Gramin sewa will also run in the village. But in the non-peak hour's DTC buses will not run and only Gramin sewa are available for villagers to travel because it does not follow any time pattern and run when all seats are occupied by the passengers. The Gramin sewa can follow the route of option 1 and option 2.

B. Fair chart

Considering all the measurements, data and all other factors, the fair chart for the DTC bus and Gramin sewa is given below in Table VII.

Chowk to GTB Nagar	
Chowk to Wazirabad:	Rs. 5/-
Wazirabad onwards:	Rs. 10/-
GTB Nagar to chowk	
GTB nagar to Burari bypass:	Rs. 5/-
Burari bypass onwards:	Rs. 10/-

Table VII: Fair Chart

C. Profit of DTC buses and Gramin sewa according to the plan

The daily expenditure on the complete maintenance of a DTC bus is approximately Rs 3000 when it would cover more than 100 km. In the above proposed plan a bus cover 5 cycles for option 2 i.e. less than 100 km. So maintenance cost of a day on bus is less than the approximate value.

DTC bus may not run in full capacity in return route in morning and evening peak hours. For the first half either in morning or evening villagers travels full distance. But for the second half, capacity is less (assume half) or we can say that passenger travel half distance. On the other hand Gramin sewa run only when all seats are occupied by the passengers. Hence capacity in return route in morning and evening peak hours will remain same for Gramin Sewa. A rough calculation of how much DTC department will earn according to the proposed plan is tabulated in table VIII. Calculation done is based on assumption that in peak hours no passenger is standing everyone in the bus will have a seat. In actually scenario in peak hours bus is fully occupied i.e. more than 50 passenger are there. Similar calculations are done for Gramin sewa is tabulated in table IX.

0

For DTC bus

1.	Total no of passengers in normal state	50 (because of 50 seats)
2.	First half travel @ Rs 10	Total amount: 10x50=500
3.	Second half travel @ Rs 5	Total amount: 5x50=250
4.	So, total amount in a cycle	750 rupee
5.	In a day a single bus cover	5 cycle
6.	Total money collect by a single bus in a day	750x5=3750 rupee

Table VIII: Money collect by a DTC bus in a single day

So, buses maintenance cost of 3 thousand rupees can easily be recovered and also DTC department get enough profits. So apart from the daily bus maintenance of Rs 3000, the DTC department can earn a profit of 750 rupees according to this plan.

For Gramin sewa

Spending part		
1.	No. of people accommodate at one time	9-10
2.	Average/mileage	15 km/kg of CNG
3.	Other maintenance cost over a month	Rs. 3-5 thousand
4.	So for a day maintenance cost	133.4~135 rupee
5.	Each half cycle is around	15 km
6.	For half cycle fuel cost	38.5 rupee
7.	Total cost of fuel in a cycle	$2 \times 38.5 = 77$
8.	Suppose in a day normally Gramin sewa complete	5 cycle
9.	Total cost of fuel in 5 cycle	$5 \times 77 = 385$
10.	Total amount spend by driver on his Gramin sewa in a day	$385 + 135 = 520$
Earning part		
1.	Suppose half travel @ Rs 5	Total amount: $5 \times 5 = 25$
2.	Other half travel @ Rs 10	Total amount: $10 \times 5 = 50$
3.	Total amount in half cycle	$25 + 50 = 75$ rupee
4.	Similarly total amount in another half cycle	75 rupee
5.	So total amount in a cycle	$75 + 75 = 150$ rupee
6.	Suppose in a day normally Gramin sewa complete	5 cycle
7.	Total money collect by Gramin sewa in a day	$150 \times 5 = 750$ rupee

Table IX: Spending and Earning of Gramin Sewa

So, Gramin sewa on an average spends approximately 520 rupees on fuel and maintenance for 5 cycles. It is estimated that the total collection for these 5 cycles according to our proposed plan would be 750 rupees giving a profit of 230 rupees per day. This amount will roughly give a minimum profit of 7000 rupees per month for the Gramin sewa. Hence, both DTC department and Gramin sewa would profit according to the sustained route plan of the village Jagatpur.

CONCLUSION

A planned route for buses and Gramin Sewa for the Jagatpur village is proposed that would help the Jagatpur Village people to connect with the main roads from where they could find further conveyance easily. This Public Transportation system in the village will be eco-friendly, economical and convenient to the villagers of Jagatpur. The sustained route plan of DTC bus (with timings) and Gramin sewa were according to the preferred route by villagers. Calculations show that DTC department as well Gramin sewa will have profit from the route plan of the village Jagatpur. It is mathematically shown how much space should be demolished near the chowk so that the DTC bus can turn easily. We realize this may be a theoretical result which may

vary from the actual implementation, but it is our strong belief that the proposal presented in this project is worth considering and must be tried for a certain trial period. Also the authors feel that this kind of a study is the first of its kind. If successful then this type of mapping and transportation systems can be planned for other villages that are in very remote places.

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